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### Beta-Convergence in African Developing Countries: a Cliometric Approach

*Amélie Charles and Laetitia Ripoll-Bresson* \*

**Abstract:** This article investigates the beta-convergence for 39 African developing countries. We consider various time periods: the full sample (1960-2001 for growth rate, 1960-1999 for real inflation and nominal exchange rate), three subperiods based on economic shocks (the Bretton Woods breakdown in 1973 and the french franc devaluation in 1994, which affects strongly the CFA french countries) and finally four of the overall sample to ten-years interval. We observe that these countries converge, notably in growth, but also in inflation and in nominal exchange rate movements. In the perspective of a monetary union in West African countries, we include a dummy variable, results are improved, according to the period, African developing countries converge.

## 1. Introduction

The notion of convergence is one of most important characteristic on the neo-classical theory. Several studies have investigated whether economies converge as predicted by neoclassical models. In this context, two economies should display the same rate of equilibrium growth but the economy with the highest savings ratio would display a higher income per capita in a stationary state.

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Baumol (1986), Barro (1991) and Barro and Sala-i-Martin (1992) conclude that economies do indeed converge. In these studies, the authors examine the cross-sectional relationship between the growth rate of output per capita over some time period and the initial level of per capita output. Several studies which analyse convergence in growth between Canadian regions and United States (Helliwell (1994), Coulombe and Lee (1993), Lee and Coulombe (1995), and Coulombe (1996)) renew debate on beta convergence. All these contributions consider beta-convergence according to neoclassical theory based on the study of output growth per capita. Evans and Karras (1996) show that this conventional approach is valid only under incredible assumptions, so they provide an alternative approach which is valid under less restrictive conditions but they fail in establishing strong differences between the two approaches. In 2000, beta-convergence is used by Gaulier and Haller (2000) to test whether automobile prices in European Union converge. So, it's possible to examine beta-convergence in another way than neoclassical theory. We aren't obliged to investigate beta-convergence only for output per capita, we are able to overtake previous analyses in including in our study another macroeconomic variables in others countries than developed ones.

In this article, we investigate the existence of convergence in African countries<sup>1</sup> since 1960. We go beyond these previous studies in two different ways, first we use three different variables. Instead of the real GDP per capita, we use the real GDP growth rate, moreover, inflation in African countries is an important issue, so we include in our study the convergence in real inflation, and finally, in the perspective of increasing integration, we add the convergence in the nominal exchange rate variations. Second, we consider various time periods : the full sample (1960-2001 for growth rate, 1960-1999 for real inflation and nominal exchange rate), three subperiods based according to economic shocks (The Bretton Woods breakdown in 1973, or the french franc devaluation in 1994, which affects strongly the CFA french countries) and finally four of the overall sample to ten-years interval.

## 2. Conventional approaches

We can distinguish two notions of convergence: the beta-convergence and the evolution of dispersion noted alpha-convergence (Diebolt (2002)). The notion of beta-convergence is based on cross-sectional data in the following form:

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<sup>1</sup> Algeria, Benin, Botswana, Burkina-Faso, Burundi, Cameroon, Central African Republic, Congo, Democratic Republic of Congo, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Mauritania, Mauritius, Niger, Nigeria, Uganda, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Chad, Togo, Tunisia and Zambia.

$$\frac{1}{T-t} \log\left(\frac{Y_{i,T}}{Y_{i,t}}\right) = \eta - \left(\frac{1 - \exp(-\beta(T-t))}{T-t}\right) \log(Y_{i,t}) + u_{i,t+T} \quad (1)$$

with  $T$  and  $t$  are the first and last year of the observation period, and  $i$  is an economic unit.  $Y$  is the variable we study (growth rate, inflation, nominal exchange rate) and  $u$  is an error term with a zero mean and finite variance. The coefficient on  $\log(Y_{i,t})$  in equation (1) is  $[1 - \exp(-\beta(T-t))]/(T-t)$ , it decreases with the length of the interval,  $T$ , for a given  $\beta$ . If  $T$  tends to infinity, the coefficient tends to zero and if  $T$  tends to zero the coefficient tends to infinity. We estimate  $\beta$  with nonlinear least-squares method. This notion is based on the fact that poor countries tend to grow faster than rich ones. Thus, the convergence coefficient exists if poor economic units tend to raise more quickly than rich economic units. If the characteristics which determinate the levels of long-run equilibrium of economies are ignored, the convergence is called (*absolute convergence*). We can observe this phenomenon only if the  $\beta$  coefficient is positive and significant. A high value of  $\beta$  implies that economic indicator in the poor country quickly approaches the level observed in the rich country.

The notion of alpha-convergence is based on time series and is usually measured by the standard deviation of the log of income per capita. The convergence is observed if the standard deviation decreases in time. Note that the beta-convergence tend to generate the alpha-convergence, but exogenous disturbances can accentuate dispersion.

### 3. Empirical results

The conventional approach to testing whether economies converge examines the cross-sectional relationship between the growth rate per capita output over some time period and the initial level of per capita output (Barro and Sala-i-Martin (1992)). These authors wonder whether poor countries or regions are able to catch up rich ones. They use the neoclassical growth model as a framework to study convergence. We differ from this approach in studying beta-convergence for African developing countries for more than one variable.

In this section, we investigate whether and how economies converge. To this we consider three data sets for 39 African developing countries. The first is constructed by evaluating the real GDP growth rate over the period 1960 to 2001, the second is the real inflation evaluated with the real GDP deflator from 1960 to 1999, and third, we take into account the nominal exchange rate (one US dollar against domestic money) from 1960 to 1999<sup>2</sup>. Barro and Sala-i-

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<sup>2</sup> The sample includes every country for which data are available, or can be easily treated. Data are extracted from the CHELEM database.

Martin (1992) consider regions instead of countries because of their similarities, but African countries in our sample seem to follow similar evolutions.

The following subsections present the results of beta-convergence for the period and subperiods for the real GDP growth rate, the inflation and the nominal exchange rate. The tables are composed of three columns : the first column presents the sample, the second gives us the beta estimation and the third gives us the  $R^2$ . The estimated coefficients for the constant are not shown in the tables. Results are based on the equation (1).

### 3.1. Real GDP Growth Rate

The beta estimated for growth rate is positive and significant at ten percent. The 39 countries slowly converge during the longest period, beta estimated is equal to 0.38%.

Table 1. Cross-country regressions for growth

Sample	Beta	t-Student	$R^2$
1960-2001	0.0038	1.72	8.59
1960-1970	0.0041	1.86*	8.91
1970-1980	-0.0011	-0.25	0.17
1980-1990	0.0016	0.76	1.56
1990-2001	0.0061	1.64*	7.24
1960-1973	0.0041	1.55	6.44
1973-1994	0.0003	0.11	0.03
1994-2001	0.0077	1.76*	8.21

\* Significant at 10%.

In order to test whether there is difference according to the subperiod, we first divide the global period in four subperiods arbitrarily (each ten years). We observe that absolute convergence is more important during two subperiods (during 1960-1970, beta-estimated is equal to 0.41% and significant, between 1990-2001, beta-estimated is equal to 0.61% and significant too). In dividing the longest period in subperiods, we note that convergence is increased, results seem to be improved if we divide the period according to criteria relative to the exchange rate regime evolutions. We observe that absolute convergence is more important during two subperiods, 1960-1973; and 1994-2001, but the former results aren't significant (beta-estimated is equal to 0.41%). After the devaluation of the french franc, convergence is increased and significant at ten percent (beta estimated is equal to 0.77%). It provides apparently strong evidence that african countries slowly converge, notably in growth during the global period and after the french franc devaluation. On our sample 12 countries belong to the CFA french franc area, and this multilateral agreement, according to us, enhances convergence. If we include a dummy variable ac-

cording to the CFA criteria, results are improved convergence increases<sup>3</sup>. We put forward the hypothesis that low convergence in growth is probably due to the diversity of production systems. For instance, there is no infrastructure in Burundi, whereas Tunisia, or South Africa are more developed. In South Africa for instance, industry is diversificated, international investments are important, whereas in Congo industry is weak and concentrated at 65 percent in agro-alimentary sector. These different kinds of production system affect strongly output growth but not too much inflation.

### 3.2. Inflation

Regarding these weak results, we decided to improve the analysis in studying another macroeconomic variables. African policymakers have long considered that a pegged exchange rate can be an anti-inflationary tool (Ghosh *et al.* (1996)).

Empirical literature underlines two important things. Fixed exchange rate arrangement provides a strong commitment and thus increases the political cost of loose monetary and fiscal policies, second, when the exchange rate arrangement is credible<sup>4</sup> pegged exchange rate arrangement has a discipline effect, notably anti-inflationary. As inflationary issue is a critical point for african policy makers, we study convergence in real inflation to test whether inflation in the 39 countries on our sample evolutes in the same direction. The following table presents results of equation (1), when  $Y$  corresponds to the real inflation rate.

Table 2. Cross-country regressions for inflation

Sample	Beta	t-Student	R <sup>2</sup>
1960-1999	0.0200	3.08**	37.62
1960-1970	0.0023	1.20	3.80
1970-1980	0.0052	1.75*	8.10
1980-1990	0.0305	2.78**	22.00
1990-1999	0.0120	1.38	5.50
1960-1973	0.0024	1.45	5.60
1973-1994	0.0279	3.21**	34.7
1994-1999	-0.0009	-0.137	0.05

\* Significant at 10%.

\*\* Significant at 5%.

<sup>3</sup> We don't report the results because we weren't here interested in the distinction: country in or out of the CFA french area.

<sup>4</sup> Several studies are interesting in this aspect Herrendorf (1999), Benassy-Quéré and Coeuré (2002) Edwards (1996), Calvo and Reinhart (2000), Frankel *et al.* (2001, 2000)).

Convergence in inflation is better than results in output growth. We estimate the beta at 2%, it's significant for the full period. It suggests that the 39 african countries effectively converge in inflation. If we divide the period in four sub-periods arbitrarily (each ten years), we observe a decrease in convergence except from 1980-1990, the beta is estimated at 3.05% and it's significant. We find the same results in dividing the longest period according to exchange rate regime criteria. Between the breakdown of the Bretton Woods system and the devaluation of the french franc, convergence in inflation is important (2.79% with a t-Student of 3.21), others periods aren't significant. Nevetheless, we note that convergence in inflation is higher than convergence in growth. All governments want their inflation decrease, to enhance their international credibility, hence, attracting international investments. So, we observe a strong convergence in inflation, notably in decreasing inflation, during the longest period 1960-1999.

The evolution of the International Monetary System since 1971 complicates the choice of exchange rate regime for developing countries. Initially, most developing countries continue to peg their currency, but as industrialized countries move towards more flexibility, several african countries follow the same direction. Hence, we test whether countries on our sample know the same behaviour in nominal exchange rate<sup>5</sup>.

### 3.3. Nominal Exchange Rate variations

Following the breakdown of Bretton Wood's system, and the widespread adoption of floating exchange rates by the major advanced economies in the early 1970s, most developing countries initially continued to peg their currency either to a key currency, predominantly the U.S dollar or the French franc, or to a basket of currencies. Starting in the late 1970s, however, a number of developing countries move away from these arrangements. At first, the shift was mainly away from single-currency pegs to pegs defined in terms of basket of currencies (Special Drawing Rights, or limited flexibility with respect to a single currency). At the beginning 80s, evolution accelerates, while in 1973, 97% of developing countries studied in our sample had some type of pegged exchange rate, by 2001, this proportion had fallen to 46 percent<sup>6</sup> So, we analyse the convergence in nominal exchange rate variations to verify if african developing countries evaluate in the same direction.

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<sup>5</sup> It should be better to study the convergence of nominal effective exchange rate, but these data weren't available for all countries, so we prefer report results for our 39 countries instead of losing several of them.

<sup>6</sup> For more details see Charles and Ripoll-Bresson (2002).

Table 3. Cross-country regressions for Nominal Exchange Rate

Sample	Beta	t-Student	R <sup>2</sup>
1960-1999	0.0210	3.28**	42.00
1960-1970	0.0015	0.79	1.70
1970-1980	0.0065	3.41**	25.29
1980-1990	-0.031	-0.86	1.41
1990-1999	0.0129	1.42	5.88
1960-1973	0.0031	1.89*	9.10
1973-1994	0.0287	3.34**	0.37
1994-1999	0.0022	0.34	0.30

\* Significant at 10%.

\*\* Significant at 5%.

The beta estimated is equal to 2.1% and significant. It's the best result, we obtain since the beginning of our study. It may mean that countries presented in our sample do mostly the same exchange rate policy, notably relative to the parity. The 12 CFA franc countries never changed their exchange rate arrangement since 1948, so their presence on the sample may improve our results. Convergence raises if we divide the period into subperiods. Actually, after the breakdown of the Bretton Woods system to the devaluation of the french franc, we observe a beta estimated at 2.87%, and significant (results are similar if we divide the period arbitrarily, convergence is high during the 1970-1980 period (0.6% significant at 5% ). Results are interesting. The choice of exchange rate regime is an important issue for developing countries. According to Mundell (1963, 1961a, 1961b), McKinnon (1963), Kenen (1969), among others, countries or regions should join an optimum currency area. Corden (2002) think that integrating an optimum currency area depends on the size of the country. For small country, monetary union or dollarisation can be a solution but for most countries, hard peg is too difficult to maintain.

However, to improve it and to take into account the aim of creating a currency union in West African Countries, we add a dummy variable in our regressions.

#### 4. The perspective of a monetary union in West Africa

On April 20, 2000 in Accra, the leaders of six West African Developing countries (Nigeria, Ghana, Guinea, Liberia, Gambia, Cape Verde) declared their intention to proceed to monetary union among the non-CFA franc countries of the region by January 2003, as a first step towards a wider monetary union including all the ECOWAS countries in 2004 (Masson and Patillo (2002))<sup>7</sup>.

<sup>7</sup> ECOWAS is composed by Nigeria, Ghana, Guinea, Liberia, Cape Verde, Gambia, Benin, Burkina Faso, Ivory Coast, Guinea-Bissau, Mali, Niger, Senegal and Togo.



These countries recognize the need for strong political commitment and undertake to pursue all such national policies as would facilitate the regional monetary integration process. From this point of view, it's interesting to study if countries belonging to ECOWAS, converge in growth but also in inflation and nominal exchange rate variations.

The equation used is the following :

$$\frac{1}{T-t} \log\left(\frac{Y_{i,T}}{Y_{i,t}}\right) = \eta - \left( \frac{1 - \exp(-\beta(T-t))}{T-t} \right) \log(Y_{i,t}) + D_{i,t} + u_{i,t+T} \quad (2)$$

with  $T$  and  $t$  are the first and last year of the observation period, and  $i$  is an economic unit.  $Y$  is the variable we study (growth rate, inflation, nominal exchange rate),  $D_{i,t}$  is a dummy variable which takes the value 1 when the country belong to the ECOWAS and 0 otherwise and  $u$  is an error term with a zero mean and finite variance.

The results are better if we compare with the results presented in table 1, the  $R^2$  is higher.

As far as growth is concerned, convergence is improved, the beta estimated increases, the t-Student too. Similarity between former results and results including a dummy variable suggest that regions converge as much as countries.

Table 4. Cross-country regressions for growth and dummies variables

Sample	Beta	t-Student	R <sup>2</sup>
1960-2001	0.0039	1.81*	12.25
1960-1970	0.0041	1.84*	8.94
1970-1980	-0.0010	-0.21	0.60
1980-1990	0.0021	1.00	13.31
1990-2001	0.0064	1.68*	8.11
1960-1973	0.0043	1.60	8.00
1973-1994	0.0005	0.18	1.21
1994-2001	0.0083	1.87*	10.61

\* Significant at 10%.

Regarding convergence in inflation and nominal exchange rate variations seem to confirm our first conclusions.

Table 5. Cross-country regressions for inflation and dummies variables

Sample	Beta	t-Student	R <sup>2</sup>
1960-1999	0.0232	3.01**	40.80
1960-1973	0.0017	0.99	9.89
1973-1994	0.0317	3.25**	38.10
1994-1999	-0.0003	-0.05	0.19
1960-1970	0.0017	0.86	5.99
1970-1980	0.0044	1.42	10.01
1980-1990	0.0362	3.10**	30.03
1990-1999	0.0125	1.31	5.26

\*\* Significant at 5%.

For inflation (table 5), results are evident, countries belonging to ECOWAS converge, beta was estimated at 2% without dummy variable and is equal to 2.32% when we take into account the region criterium, over the 1960-1999 period. Concerning the subperiods, results are similar, beta-convergence is improved for each period, except for 1960-1970 (or 1960-1973 relative to the kind of period) and 1970-1980. The perspective of a monetary union appear recently in West African countries, at the beginning of 70s several African countries, whatever the region, know several problems which may explain the decrease in convergence. For nominal exchange rate variations (table 6), results seem to be more complex.

Table 6. Cross-country regressions  
for nominal exchange rate and dummies variables

Sample	Beta	t-Student	R <sup>2</sup>
1960-1999	0.0190	3.07**	43.90
1960-1973	0.0042	2.51**	19.20
1973-1994	0.0257	2.99**	38.60
1994-1999	0.0006	0.09	13.14
1960-1970	0.0029	1.45	13.20
1970-1980	0.0077	3.78**	30.10
1980-1990	-0.0228	-0.61	16.06
1990-1999	0.0115	1.28	9.20

\*\* Significant at 5%.

During the longest period, convergence decreases; but when we divide it into subperiods, we observe that beta estimated is significant only for two periods, in using a dummy variable (1960-1973, 1973-1994). Reasons may be the following, after the breakdown of the Bretton Woods system, African countries continue to peg their currency to the french franc or to the US dollar, so converge according to their exchange rate policy, but after 1980 and with the devaluation of the french franc in 1994, each country was obliged to adapt itself

to the new financial architecture. This might explain the differences in term of nominal exchange rate convergence.

## 5. Conclusion

This paper contributes to the literature on the convergence in African developing countries. The paper also provides some strong evidence on beta-convergence according to three distinct variables. Convergence in growth, but also in inflation and in nominal exchange rate variations.

The main results are the following : first and not surprisingly, convergence in the three variables is observed during the longest period, 1960-2001 for growth, 1960-1999 for inflation and exchange rate movements. Nevertheless, according to subperiods studied, results vary. Actually, for growth, beta-convergence is significant only for two subperiods 1960-1970, and 1994-2001. According to the important issue of inflation for developing countries, we note that beta-convergence in inflation is more important and significant than for growth, three subperiods reveal beta-convergence : 1970-1980, 1980-1990 but also 1973-1994, according to the alternative criteria of division. Finally, for exchange rate movements, beta-convergence is significant during the overall period, but also from 1960 to 1973 and from 1973 to 1994, during the last period convergence is weak and not significant at all.

More importantly, results are improved if we take into account the further project of joining a currency union in West African Countries. On the overall period, beta-convergence is increased, countries that aim to join a currency union even converge since 1960. Finally, this paper illustrates why issues are different according to the periods studied. Institutional and structural reasons may be the source of this lack of convergence on short periods and should be included in further researches.

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